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COMMUNICATION BETWEEN LIGHT SHIPS AND SHORE.

THAT light ships and lighthouses will some day be included in our telegraphic system there can be little doubt. How soon this will be it is impossible to say. In some cases improvements such as this would be, are initiated by government departments through their own foresight for a public improvement, and in others a step in advance is only taken under the pressure of public opinion.

As regards the actual advantage of any work for the benefit of the public, which has never yet existed, it is only some very great event that can possibly bring such advantage prominently forward, although there may possibly lie buried many smaller circumstances, which, if known, would swell the reasons in favour of such improvement. In the case of the communication between lighthouses, lightships, and the shore, the wrecks of the *Schiller* and the *Deutschland* have pointed very distinctly to the necessity of such works, and we cannot tell how many smaller cases of distress, with loss of life, might have been relieved had such means of communication been possible.

The following extract from the able report of Mr. H. C. Rothery, the inspector appointed by the Board of Trade to inquire into the circumstances attending the wreck of the *Deutschland*, shows the importance of the subject in this case:—

"It remains for us to notice one point, which was very strongly forced upon our attention in the course of the inquiry; I refer to the question whether the means of communication between the light ships and the shore are sufficient. We have already stated that, so far as the means and appliances at their disposal allowed, the light ship people did all in their power to make the casualty known. The fact, however, still remains that this large Transatlantic steamer, with between 200 and 300 people on board, lay on a sand bank, within 2½ miles of one of our light ships, without it being possible to communicate to the shore, from daylight on the Monday morning until after dark, that anything at all was the matter; and even after night had set in, the only information, which could be conveyed to the shore was that something was wrong in the offing, but where it was, and what was the nature and extent of the disaster, no one knew until the steam-tug took the people from the wreck. All that the Harwich people knew on the Monday night was that one of the light ships was throwing up rockets, but whether this was in reply to some vessel requiring a pilot or steam tug, or what the occasion was, no one could say. They knew that something was wrong, but not that a large steam vessel was lying on one of the sands, with 200 persons on board. If the light ship had had the means of informing the people on shore of the true state of the case, it is possible that something might have been done to save them, either during the day, or in the early part of the following night. If they had known the full extent of the disaster on Monday morning, some vessel might have been sent out to her, and having ascertained her position, have lain by unti the gale abated, as we are told it did about nine in the evening, and then have taken the people from the wreck. At all events, whatever might have been the result in the present case, it is obviously very desirable that full information of any such casualty should, if possible, be conveyed to the shore at as early a period as possible. The most obvious mode that presents itself of establishing a communication between the light ships and the shore is of course by means of a telegraph wire. We were told that there are difficulties in the way, owing to the impossibility of keeping the telegraph wire clear of the cable, by which the vessel is riding. On the other hand, we were informed that there had been some such communication established between the shore and a vessel anchored away out beyond the Land's End, and that no difficulty of the kind was experienced in that case; and the only reason, as we are informed, why the vessel was removed, was that commercially it was a failure, only three vessels having communicated with the floating ship during the six weeks she remained at anchor there. It is not for us to point ont how the difficulty, if it exists, can be got over; different modes have been suggested to us by which it would seem that the object might be attained. It is sufficient here to say that, if telegraphic communication could be established between the light ships and the shore, it would un-

doubtedly be the best plan, as it would be available equally by day as by night."

That there are engineering difficulties to overcome it is true, but so there were in laying the first telegraph cables, and still more in repairing them; but they were met and overcome, and it would be absurd to suppose that the engineers who have overcome all the difficulties of submarine telegraphy could not manage to arrange a means of connecting a light ship with a telegraph cable.

In the case of the *Brisk*, the ship that was moored for some weeks off the Land's End, the engineer was not allowed a fair chance of meeting the problem, for a naval officer on the Board took the whole matter in hand and obtained an old man-of-war from the Admiralty, which was in no way adapted or fitted for the purpose. No precautions were taken to overcome the difficulty of swinging, or to make the ship tolerably steady. Consequently difficulties occurred with the cable, and the ship rolled those on board nearly out of their senses.

There are several ways of meeting the difficulty of swinging, Sir S. Canning, Mr. Henley, and Mr. F. C. Webb, each having plans; but even if all of these failed, some plan would soon be devised when once an experiment is properly made. It only requires that Government should be in earnest and intend to carry out the work to one or two ships as experiments.

We have been informed that the Board of Trade do not intend at present to try any experiments on the subject, and we have heard that one of the reasons why it is determined not to adopt an electric telegraph is, that as it would only be required occasionally it would be sure to be out of order when wanted. It seems to us that if this is the only difficulty, it could be got over by insisting on messages being sent every day, or, if necessary, every hour. But it also appears to us that if the system was once extended to all lighthouses or lightships, ships would often be glad to communicate on commercial matters, and that it would be easy to arrange for the payment of such messages. The fact that the *Brisk* is said only to have taken three messages is scarcely to the point. In the first place, the ship was not there long enough to become known; and, in the second place, if there are many points at which ships could communicate with the shore, telegraphing is much more likely to become a regular custom. By a paragraph we print on another page from a daily journal, we gather that the Trinity Board have been trying experiments at Harwich with carrier pigeons. This seems very much like returning to bows and arrows in the days of Martini rifles and 81-ton guns.

ON THE NATURE OF THERMO-ELECTRICITY.

THE nature of the electricity which arises when two different metals are connected in a circuit, and the places of contact of the heterogeneous metals have different temperatures, has been the subject of a good deal of speculation. In a recent number of *Poggendorff's Annalen*, M. Kohlrausch advances an hypothesis in regard to it, the salient features of which we shall here endeavour to present.

"It is usual," he observes, "to place the cause of thermo-electricity in an electro-motive force at the places of contact of the different conductors, but difficulties are met with whenever it is sought to pass to definite conceptions here. The voltaic contact forces (which in the ordinary voltaic pile are accepted as the cause of the galvanic current) have evidently helped towards this hypothesis, and the next step consisted in explaining thermo-electricity as a modification of voltaic forces through temperature. But we soon perceive that in that case the ideas hitherto held as to these forces must be given up, or if this be not done, that we must again keep separate two kinds of contact forces.

"In this state of things, the remark is perhaps not superfluous, that for a theory of thermo-electricity, we do not at all require the immediate action of contact surfaces, and that we may reach a perfect agreement with known facts, if we suppose the electro-motive force to be in the interior of the separate conductors. The places of contact have then only a secondary influence. This conception we shall here develop.

"In every thermopile, when in action, there is, with the difference of temperature, necessarily a streaming over of heat from the warmer to the colder junction; because every conductor of electricity also conducts heat. Hitherto the difference of temperature of the junctions has been regarded as the cause of the electro-motive force; but with equal right we may make the attempt to lay, as basis, the other inseparable condition. We accordingly suppose, that *with a heat current* of determinate amount depending on the nature of the conductor, *an electric current is connected*, provided that other electro-motive forces are first excluded."

This idea is, indeed, not entirely new. Some years ago M. L. Hermann arranged experiments that were based upon it, and were meant to confirm it, but without success. M. Kohlrausch has now taken it up, and subjected it to a purely theoretical discussion.

Starting with the supposition that when a certain quantity of heat passes through a surface element in the interior of a conductor, a certain quantity of electricity is carried away with it, from the latter being proportional to it and dependent on the nature of the substance, M. Kohlrausch develops the formula for the electromotive force of two metals, which have different thermoelectric constants, and different falls of temperature, and this formula shows (what experiment confirms) th the electromotive force only depends on the temperature of the junctions, and is proportional to the difference of temperature.

M. Kohlrausch demonstrates that in a homogeneous uncrystalline conductor of varying temperature, a continuous electric current cannot arise, because there is soon an accumulation of free electricity, which compensates the electromotive force of the heat current. On the other hand, electricity has been observed in crystalline bodies, *e.g.*, in tourmaline, during the motion of heat in their interior.

Every theory of thermo-electricity, however, must explain not only the electromotive forces, but also the so-called Peltier phenomenon, that is, the development of heat at the soldered junction of two metals when an electric current is sent through them. "The necessary supplementing of the above hypothesis for this end," says M. Kohlrausch, "is almost offered by itself, for we have only to add the supposition that *by an electric current heat is moved*. This supposition comes to agree with the known quantitative facts regarding the Peltier heat, when the reciprocity of joint conduction of electricity and heat is extended also to the amount of this." M. Kohlrausch shows that this propagation of heat in a conductor cannot, on account of the equality of the thermoelectric constants, produce any action. At a junction, on the other hand, where these constants are different, there will be manifested, according to the direction of the current, heat production or absorption.

We may give this hypothesis a very simple expression if we take into consideration the proportionality, rendered highly probable by Wiedemann and Franz, between conducting power for heat and for electricity. That is, the heat-giving power of unit electric current in any body is proportional to the electromotive force of the unit heat current in the same body.

While all the known facts of thermo-electricity are deducible from this position, there are, further, two quite unimportant consequences, which are peculiar to it, viz., first, an electric difference between two points of a body of varying temperature, and second, a difference in the heat developed by an electric current in an unequally warm conductor, according to the direction of the current. * * * * * *

In favour of the views here given, the following may further be remarked: that the propagation of heat and electricity in a metal are nearly allied phenomena, follows from the proportional behaviour of all metallic conductors, that have been experimented with, with regard to both conductions. At least we have in heat and electricity two somehow related things which fill the same space, and however it is to be conceived, we may expect that the movement of one of them has a moving influence on the other. * * * *

Further, the remarkable fact that the most active thermo-electric bodies are very bad conductors, speaks in favour of some connexion of thermo-electricity with conduction of heat and electricity, for a mere coincidence can here have no place.

Lastly, it is to be noted that that excitation of electric properties, which is denoted by the name of pyro-electricity, appears to stand near our conception of thermo-electricity. The crystals in question are found electric only during their heating or during their cooling, that is to say, when they are traversed by a heat current. It is possible that thermo and pyro-electricity are merely different expressions of one and the same reciprocal action between heat and electricity.

BLOCK SIGNALLING.

(Continued from page 84.)

WALKER'S Semaphore instrument, produced in 1863, would appear to be the first which worked both bell and semaphore with one wire. In or about 1866, it was much improved by the addition of the locking gear which it now possesses and which prevents any alteration of the signal without the aid of the current.

Figure 21 gives an outward representation of

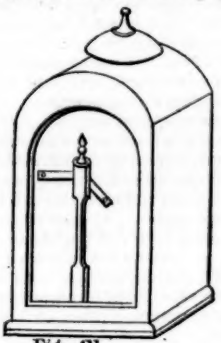

Fig. 21.

the instrument. The arm to the left of the post is the "block" arm, and is coloured red; that to the right is white, and indicates the position of the adjoining signal box, or more strictly, the nature of the current last sent to such signal box. The "block" arm is worked from, and is under the control of, the adjoining signal box. The right arm is worked by the outgoing current.

Figure 22 is a side, and figure 23 a back, elevation, showing the arrangement for working the "block" arm and ringing the bell. The arrange-

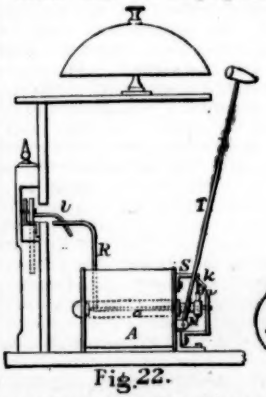

Fig. 22.

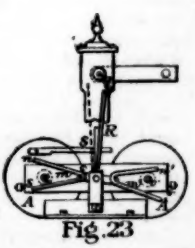

Fig. 23

ment for working the white arm is above this, and, except that it is reversed, is similar but smaller. As its action is the same, it has been left out of the drawing for the sake of simplification.

A A are the coils, C C the cores, M the armature carrying the bell hammer T. A current passing through the coils attracts M and produces one stroke on the bell. When the current ceases, the armature is brought to its position of rest by the spring S. So far, the direction of the current is immaterial: whether positive or negative; the armature is attracted and the bell struck. The action of the arm is produced by means of two bent steel permanent magnets, m, m joined together by a piece of brass B, which is pivoted in its centre. It is evident that the passage of opposite currents through the coils producing opposite magnetism in the cores c, c', will produce an opposite movement in the brass bar B. The motion thus obtained is continued to the rod R, rigidly fixed at right angles to B. The semaphore arm is so arranged that it shall fall to clear by its own weight, provided the rod R is in such a position as will admit of it. Its movement being governed by the small wire bar l, attached to the arm in the manner shown in the figure.

Each station is provided with a reversing key, furnished with two knobs, or push pieces—one for the *clear* signal, the other for the *block* signal. This key is usually so fixed that the upper knob shall, when pressed, send the block signal and the lower one the clear signal. The arrangement of the key is of the usual kind; the pressure of one places one pole of the battery to line, and the other to earth; whilst the same action with the other produces the reverse. With the one key we therefore get a copper current to line, and with the other a zinc current.

Reverting now to figs. 22 and 23, it will be seen the rod T, in connection with the armature M, has attached to it a pin *k*. This pin governs the movement of the rod R, retaining it in the position last placed, so long as the armature M is at rest. If we now follow the action of a current through the instrument we shall see more clearly the duties of the several portions. Let us assume the arm is in the position shown, and that it is desired to lower it to the "all clear" position. The distant station presses the lower knob of his sending key, a current passes to line and enters the receiving instrument, where it passes through the coils AA to earth. The cores c,c', are now magnetized with an opposite magnetism to that with which they were charged to raise the arm to danger. The one to the left, c, now presents a south pole, whilst c', possesses a north polarity. The armature M is first attracted and the bell struck, by which movement the pin, *k*, is carried forward free of the locking pin shown at *m* (fig. 22). The magnets, m, m^1, are now free to move, *s* attracts *n* and repels *s*; c^1 attracts s^1 and repels n^1; the bar B, carrying the two magnets m, m^1, moves from the position shown in the figure to its opposite, and the rod ,R, being carried with it assumes that position shown by the dotted line; the pin, *l*, following it, the arm is lowered to the all clear position. The armature M now falls back under the influence of the spring S, and the pin, *k*, locks the rod, R, at the all clear position.

At the instant the sending station pressed the knob of his lower key, by which a current was sent to line, a current from the opposite pole of the battery passed to earth at this station. In its course it passed through the upper pair of coils of the instrument, lowering its white arm to all clear in a similar manner to that by which the opposite current lowered the red arm at the receiving station, giving the man sending the clear signal a record that he has done so.

The sending key is so arranged that it shall have no influence over the red, or block arm, whilst both knobs shall actuate the white arm. Thus when a block signal is sent, which is done by pressing the upper knob, the white arm at the sending station is raised to the horizontal position; and when the clear signal is sent, by pressing the lower knob, it is again lowered to the all clear position. This is done in each case by bringing the upper coils of the sending instrument in circuit between the sending battery and the earth.

The instrument is simple in its arrangement, and capable of being easily maintained. It should work well with a *quantity* battery. Its signals are reversible by lightning, and its record—the white arm—of the signal at the distant station is not thoroughly reliable so long as the outgoing current finds earth, whether at the distant box, or before it reaches it, the movement of it would take place precisely the same as though the current had passed through the instrument at the distant station.

THE NEW ZEALAND CABLE.

The following particulars relating to the Cable recently laid by the Telegraph Construction Company for the Eastern Extension Telegraph Company, will be of interest to our readers:—

Core, ... 107 lbs. Copper.
... ... 140 „ G. P.

Lengths of Cables manufactured.

Type			Knots.	Weight. per knot Tons.
A.	10 B. B.	galv. iron wires, No. 00, B.W.G. —	10	12.5
„	B. 10 B. B.	do. „ 6, B.W.G. —	59	3'9
„	C. 15 homo	do. „ 13, B.W.G. —	300	1.5
„	C. 9 „	do. „ 13, B.W G. —	1001	1.3
		Total	1370	

Manufacture commenced 11th August, 1875.
Manufacture completed 28th October, 1875.
The cable was shipped on board two ships, viz.,
" Edinburgh," ... 183 knots.
" Hibernia," ... 1187 „

Total 1370

Mr. Charles Hockin (of the firm of Messrs. Clark, Forde, and Co.), accompanied by Messrs. R. E. Peake and E. Archdale, represented the Eastern Extension, &c., Telegraph Company.

Mr. Lucas, Engineer-in-Chief, and Mr. J. C. Laws, Electrician, represented the Telegraph Construction and Maintenance Company.

The Engineering staff of the Construction Company consisted of Mr. E. Riddle, Mr. H. M. Wattie, Mr. J. Shirwin, and the Electrical staff at sea being Mr. H. C. Donavan, Mr. J. Clark, Mr. Stringer, and Mr. W. Granville.

The electrical staff ashore were Mr. Brown, Mr. E. A. Stephenson, Mr. W. Downing, Mr. J. Kimberton, Mr. J. Redgrave, Mr. Clack, and Mr. Kingsford.

The ships commenced laying the cable from Botany Bay, Australia, 7th February, 1876, and completed laying to Nelson, New Zealand, 18th February, 1876. Cable laid, 1,283 knots, approximate; distance over water, 1,125 knots, approximate; maximum depth of water, 1,975 fathoms, approximate. Cable in perfect condition, and tests most satisfactory.

Notes.

MR. GEORGE M. BEARD has reprinted, from the Archives of Electricity and Neurology for 1865 (New York), a paper, headed "Experiments with the alleged New Force."

A pamphlet has been issued, entitled "The action of Light on Selenium," by Willoughby Smith. It contains a copy of a letter from Mr. Smith to the Secretary of the Society of Telegraph Engineers, dated March 3rd, 1876, giving a history of the discovery. It appears that in 1866, having to fit up the apparatus for his well-known system of testing submarine cables during the paying-out operations, which requires a resistance of 100 megohms, while searching for a better substance than gelatine to form the resistance, the high resistance of selenium was brought to his notice. "I obtained," writes Mr. Smith, "several specimens of selenium, and instructed Mr. May, my chief assistant at our works at Greenwich, to fit up the system we adopt on shore during the laying of cables, using selenium as the high resistance, and employing the spare members of the staff as though they were on shore duty, and to report to me on the subject. It was whilst these experiments were going on that it was noticed that the deflections varied according to the intensity of light falling on the selenium." The pamphlet also contains a letter to Mr. L. Clark, dated 4th February, 1873, giving details of the experiments. This was read before the Society of Telegraph Engineers.

In our last we mentioned that the Committee appointed by the Admiralty, the Board of Trade, and the Trinity House, to consider the rules of the road at sea, had issued their report. Amongst the alterations proposed, is the following relating to telegraph cable ships:—"Art. 5. The following ships, viz.—A steamship laying or picking up a telegraph cable; a steamship which, in consequence of accident to her machinery or steering gear, or for any other reasons, is not under command, shall, by day, carry in a vertical line, one over the other, not less than three feet apart, in front of but not lower than her foremast head, three black balls or shapes, each two feet in diameter; and shall at night carry, in place of her masthead light, three red lights in globular lanterns, each not less than 10 inches in diameter, in a vertical line, one over the other, not less than three feet apart. These shapes and lights are to be taken by approaching ships as signals that the ship using them is not under command, and cannot therefore get out of the way. The above ships, when not making way through the water, shall not carry the side lights, but when making way shall carry them."

These proposed regulations have been submitted through the Foreign Office to all the countries which have adopted the existing International Regulations, and of course must be endorsed by them before they can become law.

It was certainly time that something was done as regards the lights of telegraph ships. In 1862 Sir S. Canning called the attention of the Admiralty to the subject, and in August of that year the Admiralty issued an order compelling all ships laying cables to carry two red lights at night in addition to the side lights and masthead lights, and two black balls at the foremast head by day. The order was not sufficiently published, and the late Shipping Act ignoring it altogether, it was no longer legal to carry these lights.

The present proposal does not seem a good one, as the same lights are to be used by steamers that are broken down as by a telegraph steamer. The consequence will be that every telegraph steamer will be taken for a broken down steamer, and consequently ships will bear down on them to see if they require assistance. It was greatly to prevent this that special lights for telegraph ships were required, as ships often come ranging alongside a telegraph ship at night, thinking she is a disabled ship and adrift like themselves, to ask if they want assistance; whereas the telegraph ship is perhaps moored by the cable she is picking up, and thus there is danger of the other ship drifting on to her. It will also be seen that if this proposal is made law every ship will have to carry on board three red lights and three balls so as to have them ready in case she breaks down.

Mr. L. Clark read a paper before the members of the Institution of Naval Architects on April 7, "Description of the Nicolaiff Floating and Depositing Dock, now being constructed for the Russian Government at Millwall, by Messrs. Clark, Standfield and Co." This dock is designed for the purpose of raising the large circular ironclads of the Russian Government.

The s.s. *International*, Capt. Beesley, left the Thames on the 3rd to proceed to Bilbao to replace the Direct Spanish Cable in connection direct with Bilbao instead of Santander. Mr. Benest is in charge of the operations for the Direct Spanish Company.

In the circular issued by the Council of Education regarding the forthcoming loan exhibition of scientific apparatus at South Kensington, the following is a list of the instruments connected with magnetism and electricity which are suggested by the committee as of interest—

Magnetism.—Instruments and apparatus employed in teaching, and in the investigations and observations connected with natural magnets; permanent artificial magnets; electro-magnets; methods of magnetization—effects of magnetization: conditions affecting intensity of magnetization: temperature (chemical), composition, strains, &c.; magnetic induction of all substances—diamagnetism; measurement of intensity of magnetization, magnetic moment; terrestrial magnetism—instruments for observation and automatic registration of the magnetic elements.

Electricity. — Instruments and apparatus employed in teaching, and in the investigations and observations connected with production and maintenance of difference of potential — electrical machines acting by friction, induction (doublers, replenishers, &c., Holz's and Töppler's machines, &c.); galvanic batteries; thermo-electric piles; magneto-electric machines. Other sources, such as pyro-electricity, pressure electricity, cleavage, capillarity, osmose, &c. Detection and measurement of difference of potential — electroscopes, electrometers, standards of electro-motive force, methods of comparison. Accumulation of electricity—insulators, condensers, accumulators, effects due to accumulated electricity, distribution on conductors, polarisation of dielectrics, &c. Measurement of electric quantity—torsion balances, standard accumulators, methods of comparing electric capacities and dielectric coefficients. Detection and measurement of electric currents—galvanoscopes, galvanometers, voltameters, electro-dynamometers, &c. Resistance—standards of resistance, methods of comparing resistances, methods of establishing absolute standards (British Association unit appar.). Effects of electric currents—production of light, heat, electrolysis, electro-diffusion, action on magnets, soft iron (electro-magnets), action of currents on currents. Technical application of electricity—electric telegraph, &c.

A paper (from the *Quarterly Journal* of the Meteorological Society for October, 1875), entitled "Remarks on some practical points connected with the Construction of Lightning Conductors, by Robert James Mann, M.D., F.R.A.S., has been reprinted in pamphlet form, together with the discussion on the paper. It contains much information of interest on this subject.

We have received from Philadelphia a copy of the second number of the *Polytechnic Review*, a journal devoted to science as applied to the useful arts. It is quarto size, with a cover, well printed on good paper, well illustrated, and seems to contain good articles on mechanical and scientific subjects.

The *Revista de Telegraphos*, the Spanish telegraphic paper, re-appeared last January after a lapse of some years.

The same journal announces the death of Don Hippolyte Araujo, inspector of telegraphs and delegate from Spain to the Rome Conference. He had also visited London during the 1862 Exhibition, and in 1871 he inspected the cables made by Mr. Henley for the Balearic lines.

In the *Journal Telegraphique* is a paper by Paul la Cour, of Copenhagen, on a new system of telegraph, which he calls *Phonotélégraphic.*

The *Journal Telegraphique* has an article, headed "The Submarine Communications of the World," giving a very complete list of cables at present laid.

The Vigo-Carcavellos cable, interrupted since the 5th of February, was repaired on the 24th of March.

The *Professor Morse* repairing ship, belonging to the International Ocean Telegraph Company, sailed, on 23rd of March, from New York, to repair the 1868 Cuba and Key West Cable. The steamer is under the command of Captain Thomas J. Stead Mr. G. A. Hamilton, of the Electricians' Department of the Western Union Telegraph Company, assisted by Mr. A. S. Downer, of the Western Union, takes charge of the electricians' arrangements and tests. Captain William Mackintosh, superintendent of construction and repairs, also accompanies the expedition to oversee things generally.

The fault in the cable is located about two or three miles from the Cuban coast, and is in 500 or 600 fathoms of water. The grappling apparatus was made in England under the supervision of Sir Samuel Canning. The ship carries 10 miles of "intermediate" cable.—*Telegrapher.*

The Western and Brazilian Telegraph Company (Limited), on the 10th of this month, received intimation that communication by their cable between Monte Video and Chuy is interrupted.

The Indo-European Telegraph Company intimate that the average time in transit of all outward messages between London and India *vid* Teheran, including the messages for Penang, Singapore, China, Japan, Java, and Australia, during the week ending April 7, was 43 minutes.

In the papers from Australia, dated Feb. 24, it is stated that the United States' man-of-war *Tuscarora* was at Brisbane, and was about to proceed *vid* Sydney to Auckland, whence she was going to take soundings to New Caledonia and Fiji, with the object of finding out the best ground for a telegraphic cable.

The Legislature of Western Australia had been prorogued until April 3. Now that the New Zealand cable has been laid, and is in operation, it is hoped that the overland line between Western and Southern Australia would be speedily completed. Already 150 miles had been laid down from Eucla.

Experiments in electric lighting have been continued at the Northern Railway Station, Paris. We hear that the Northern Railway Company will, if these trials are satisfactory, light the arrival shed by electricity. This shed has a cubic space of about 300,000 cubic metres. For this purpose four electric lights will be used, rather more powerful than the one used in the luggage rooms and the custom house, which is employed from five o'clock till midnight. At the trials of which we speak a Gramme machine was being used, giving a light equal to 100 jets of gas, consuming 150 litres an hour. Lately experiments with the photometer and dynamometer have been carried on at the lamp factory of Messrs. Sautier and Lemmonnier. The result of the trials show that this powerful Gramme machine gives a light equal to 1,850 Carcel burners. The equivalent consumption of oil would be (reckoning 40 Gramme an hour per burner) 71 kilogrammes an hour; of gas 194 cubic metres, say about 650 kilogrammes of coal. The cost of electric lighting is about one hundredth part that of oil.—*Moniteur Industriel Belge.*

In Lloyd's List of the 21st March the following appeared:—"Halifax, 6th March. As the *Faraday* was coming out of Torbay she struck a ledge of rocks. On the 3rd and 4th March the vessel's bottom was examined by a diver, and her stern rudder found to be damaged. It was unshipped on the 4th. The diver has not yet completed his examination, and it is impossible to tell what is the extent of the damage.

In our number of March 15th we commented on the price that had been paid by the Eastern Extension Company for the s.s. Edinburgh as given by the reports of the meeting of the Eastern Telegraph Company, when the Chairman, Mr. S. Pender, is reported to have stated that the ship had been obtained for £15,000. It has been intimated to us since, that the ship was included in a general contract for cable and ship, and that consequently no special sum was mentioned as the price of the ship alone. We can only say that we used the information given by the reports in the daily papers. We cannot recollect the particular paper from which we first saw the report of the meeting, but we here quote a portion of the speech of the Chairman, Mr. J. Pender, as given in the *Financier*, of December 31st, 1875, page 7, first column:—"But in the arrangement with the Telegraph Construction Company this Company got a ship for £15,000, which was worth a good deal more."

Surely the Chairman of a buying company ought to know what he gives for the articles he buys, and if he does not, and assumes and states a wrong price, neither those who report for the daily journals, or those who comment on such figures when published, can be to blame.—ED.

From time to time we hear of the marvellous victories which have been gained over time in the transmission of telegraphic messages. Few, if any, however, are more deserving of record than that which was achieved by the Direct United States Cable Company on Saturday last, in connection with the Oxford and Cambridge boat-race. The message announcing the result of the race reached New York *twenty seconds* after it was received at the company's office in Throgmorten-street. Reports as to the speed of working and carrying power of the new cable have already appeared in the columns of the *Journal*, but so striking an instance as this deserves even more than a passing notice.

Proceedings of Societies.

THE SOCIETY OF TELEGRAPH ENGINEERS.

(Concluded from page 106.)

THE secretary then proceeded to read a very interesting communication which had been received from Mr. Sabine with reference to Sir Charles Wheatstone's early ideas of a submarine telegraph. This was accompanied by carefully executed drawings, to illustrate the type of cable to be employed and the mode of submergence to be adopted between France and England. From the letters in Mr. Sabine's possession it is found that as early as 1837 this was a subject in which Sir Charles Wheatstone was taking the greatest interest. It was when under examination before a Select Committee of the House of Commons some years later—the 6th of February, 1840—that he gave the reply which has now become historical, as to the practicability of establishing electrical communication by means of a cable between Dover and Calais. Towards the close of 1840 the drawings, which were exhibited, were executed. One of these shows very clearly the method of insulating and manufacturing the cable, as well as the means to be adopted for shipping it; the other shows the route to be taken and the methods of laying, join-

ing, and, if need be, undermining the cable. From a note that each wire should be the core of a rope line well saturated with boiled tar, and that the lines should finally be made into a rope treated in the same manner, one can form some idea of the nature of the cable which was contemplated. The scheme of connecting France and England expanded in the following year, 1841, into one for connecting Portpatrick and Donaghadee, and laying a cable across Portsmouth harbour from Portsmouth to Gosport. The Channel telegraph still, however, retained the uppermost position in his mind, and with this object in view a preliminary experiment was carried out in September, 1844, with some insulated wires submerged in Swansea Bay. The communication was preserved with the Mumble-head Lighthouse, and it is interesting to note that the old lighthouse-keeper, who had been an assistant in some department to Sir William Snow Harris, exhibited the keenest possible anxiety as to the result of what was going on, and rendered all the assistance in his power by reading the signals and communicating with those who were out in the boat. A letter from Wheatstone to Captain Beaufort, R.N., of the Admiralty, written in September, 1845, shows that the Channel project was still prominent in his mind, and from the pointed inquiries which it contains give evidences of the shrewdness and far-sightedness of the man. In these inquiry is made as to the action of sea-water upon lead, from which it would appear that he had some idea of employing this metal as the protective covering. As early as 1845 it would appear that Sir Charles Wheatstone intended to employ guttapercha in connection with his cable, although in what capacity is not clear. In that year he endeavoured to obtain some, but failed, owing to the fact that the last parcel had been bought by Mr. Hancock, of Charing-cross, and that all the expected supplies for the next two years had been bought up by some one who had a patent for the use of it in connection with an atmospheric railway.

Mr. F. C. Webb (responding to the President's invitation) commenced by referring to the very early days of submarine telegraphy. He was present at the laying from the *Goliath* of the unprotected guttapercha insulated wire from Dover to Cape Gris Nez, which ought to be recorded simply in the light of an experiment. Subsequently the *Blazer* paid out the existing 4-wire Dover to Calais cable, which after the lapse of a quarter of a century is still at work. Even that ought to be regarded as little more than an experiment, for scarcely any machinery was employed in the operation. The first cables laid by anything like mechanical means were those by Messrs. Newall, between Holyhead and Howth and Dover and Ostend. These were the earliest occasions on which the drum break was used. Now we have the Appold break added instead of the ordinary strap and lever, but the drum now used is precisely the same as that introduced by Messrs. Newall as far back as 1853. Mr. Webb then proceeded to explain the various breaks which have from time to time been tried, and went on to say that seeing how we had come back to the old drum break, in some cases with the Appold break, but in others with only the ordinary strap and lever, he could not but think that it redounded greatly to the credit of Mr. Newall that what was used by him at the birth, so to speak, of submarine telegraphy, should be taken up and all but universally employed even now, with all the accumulated experience of later times. With reference to the historical portion of the subject, the Spezzia-Corsica cable was the first one in deep water, laid by Mr. Brett along with Mr. Thompson, one of Mr. Newall's head assistants. In some places the depth was as much as 500 fathoms, and as the cable weighed about 7 tons to the mile, extra precautions had to be taken with the break power. Two ordinary drum breaks, each with double straps and five turns round each drum, were employed and answered the purpose. The same machinery failed in the following year with a 6-wire cable. After two starts from the land about eighty miles of cable were brought back, whilst sixty miles were picked up afterwards by Mr. Liddell and Mr. Webb in the *Elba*. This was the first heavy cable picked up from deep water.

In the case of the Bona-Cagliari cable mention is made of water-tight tanks having been used. That is hardly the case; they were iron tanks, but never intended to be water-tight. There is one historical fact in connection with this cable which deserves to be mentioned. It was the first cable on which a dynamometer was made use of. Its employment was first recommended by Dr. Werner Siemens, and adopted by Mr. Newall. Mr. Webb then entered into a minute description of this dynamometer, and the various improvements which have since been effected in it.

Mr. Webb confessed himself unable to answer the question put in the paper as to whether the formulæ of Messrs. Longridge and Brooks are correct or not. Considering, however, the number of cables whose submergence has been based upon the calculations of Messrs. Longridge and Brooks, he could not help thinking that if there was anything materially wrong it would have been pointed out long ere now.

It is true that no verification of these formulæ has ever been tried, and there appears to be no way of showing how far they are correct to the farthest extent, but looking at the matter generally we know that so far as the relation of speed, strain, &c., is concerned, this theory accords with practice. There are many points in connection with this paper of Messrs. Longridge and Brooks which deserve the special consideration of all engaged in cable laying. One point, especially, is that of the ship being stopped suddenly while paying out, and remaining stationary. The cable, which has been descending in a straight line inclined to the horizon, will there assume a catenary, and if the cable has been paid out without the proper amount of slack, a great strain is thus thrown upon it. Again, if the cable in descending comes suddenly upon a ridge of high ground, then unless time is given for it to accommodate itself to the sinuosities in the bed of the sea, and unless the proper amount of slack is likewise allowed, the cable again forms a catenary, and in time is snapt asunder. This, it was submittcd, might be the cause of some of those mysterious breakages which have occurred on submarine cables, and of which no satisfactory explanation has hitherto been given.

The discussion was then adjourned to the meeting held on the 22nd of March.

PHYSICAL SOCIETY.

(Concluded from page 108).

PROFESSOR JOHNSTONE STONEY then explained the theory which he has suggested in explanation of the phenomena observed in the radiometers of Mr. Crookes, which has been published in the *Philosophical Magazine* for the current month. The theory rests on the supposition that there is an excessively small trace of residual gas in the sphere in which the moving discs are enclosed. When the apparatus is exposed to heat the blackened side of the disc is slightly warmed, and this warms a layer of air in contact with it. At the ordinary atmospheric pressure, Professor Stoney assumes the layer so warmed to have the thickness of a sheet of paper, when the temperature of the disc is 20° C above that of the surrounding air, and on such a supposition we may calculate it for any other pressure and temperature. If we diminish the pressure the thickness varies inversely as the pressure raised to the power $\frac{1}{4}$. Thus, if the disc be raised $\frac{1}{10}$° C above the surrounding air, and the exhaustion carried to the $\frac{1}{10000}$th of an atmosphere, the layer will have a thickness of more than a decimetre, and the effect of the air will then be peculiar. If the gas is of such a density that the glass envelope is beyond the range of this action, the gas beyond the limiting distance will be cold; but if the effect reach the glass, conduction will take place to it. There will then be a procession of warm molecules towards the glass, where they will be cooled down, and form a number of cold, slow-moving molecules, which will go back to the disc and beyond it. And these processions will be intermixed with molecules taking no part in the action. In consequence of this, very few members will travel far in their paths; a portion of the motion of each, however, will be carried forward in the right direction. So long as these processions go on, the slow-moving molecules which reach the front of the disc are thrown off more vigorously than from the back. Professor Stoney considers the pressure thus produced to be that measured by Mr. Crookes. With a pressure of the gas of $\frac{1}{10000}$th of an atmosphere, an elevation of temperature of $\frac{1}{10}$° C will produce the force actually observed, while if the exhaustion be carried to $\frac{1}{1000000}$, the elevation of temperature necessary will be $\frac{9}{10}$° C. Thus with the greater pressure a lower temperature will suffice, but other influences will then be brought into play, tending in an opposite direction. It was pointed out that on this theory the action may be considered as closely resembling electricity, and Mr. Crookes has shown that the glass envelope is often itself slightly electrified.

Mr. Crookes considered that $\frac{1}{10}$° C, the temperature assumed by Professor Stoney, was far in excess of what actually is required to produce the observed effects, for the discs are strongly moved by "cold" heat falling on them, for example, when placed in front of a window or close to a wall. With discs of platinum there is attraction throughout all the stages in the exhaustion from 1 m. m. of mercury until a fairly perfect vacuum is attained. If, however, the exhaustion is continued, we reach a neutral point beyond which there is strong repulsion, and this is strongest in the very best vacua which will not conduct an induced spark. Professor Stoney would seem to show that the action should vary with the size of the apparatus; but this is not found to be the case. Mr. Crookes inquired whether the extremely rapid rotation of the discs would not interfere with the "processions" of molecules.

Professor Stoney pointed out the enormous velocity of the molecular motions in proof that the rotation of the discs would be without influence. Thus in such a gas as oxygen the velocity of the molecules is about 500 metres per second. The fact that similar velocities of rotation are observed in radiometers of different diameters only shows that they are all within the limits of the thickness of the layer which he considers to produce the effects observed.

On the 25th ult., Professor G. C. Foster, F.R.S., President, in the chair, the following candidates were elected members of the Society:—The Marquis of Salisbury, Professor Liversidge, W. Ackroyd, Tolver Preston, and W. Merritt.

Mr. O. J. Lodge, B.Sc., made a communication on "The Flow of Electricity in a Plate," in continuation of a paper which he read before the Society on the 26th of February. In order to apply the principle of images already described to the flow of electricity in plates bounded by straight lines, it is necessary that the angles of the plate should be aliquot parts of 180°; and, since this condition excludes obtuse angles, the number of rectilinear figures which can be treated is very limited. They are rectangles, equilateral triangles, two cases of right-angled triangles, the two limiting cases of isosceles triangle for which the equal angles are 0° and 90° respectively, and many cases of the general two-sided polygon or "wedge," including the regular two-sided polygon or "strip." Since the images of a pole in a wedge lie on a circle as in a kaleidoscope, Cotes' property of the circle may be applied to obtain expressions for the potential of any point, and for the electrical resistance of the plate to the flow from any number of point-poles situated anywhere in it. The expressions are rather long, but they become simpler in certain special cases which were pointed out. Making the angle of the wedge vanish, the expressions modify into corresponding expressions for the strip, the resistance expressions of which always contain hyperbolic trigonometrical functions of the positions of the poles. The potential function for a circular sector also follows from the general case of the wedge. The general resistance formula applied to the case of the isosceles right-angled triangle leads to some continued products, all of which are generalizations of Wallis' expression for $\frac{1}{2}\pi$. The product of these products, which is itself of the same form, has been reduced by Mr. J. W. L. Glashier to the complete elliptic integral usually denoted by K, its modulus being Sin 45°. This quantity appears in all the resistance expressions for right-angled triangles and squares which the author has yet examined. The case of an equilateral triangle leads to more complex and interesting products, which were reduced by Mr. Glaisher, to the product of two theta-functions with Sin 75° as a modulus. When the conditions of flow are known in one rectilinear figure, they may be extended to a large number of others by alternate processes of reflecting the plate in one of

its own boundaries, and of cutting it along one of its straight flow or equipotential lines. Diagrams of such transition figures were shown. In order to obtain the resistance of a compound conductor by means of the known resistance of its components, it is necessary that the flow conditions in each component shall remain entirely unaffected by their being connected together. Thus, if the resistance of a circuit consisting of two wires, side by side, is to be deduced from the resistance of the wires separately, by the ordinary method of adding their conductivities, it is necessary either that the wires shall not touch each other or that, if they do, no flow shall pass across the junction. This rule is often overlooked, and the oversight has given rise in certain cases to a notion of electrical "interference." The concluding part of the paper has to do with the flow conditions when line poles are combined with point poles in a sheet, especially when point electrodes are introduced into a sheet when a uniform current or "river" is flowing across the sheet.

Dr. Guthrie referred to experiments which he had made on the subject with the aid of a magnetic needle, but the results were of course interfered with by the lines of flow. He suggested as another subject deserving of investigation, the flow of electricity through a network of wires, which might, perhaps, be considered as a case of one dimension.

Mr. Lodge had not investigated such a case, but thought it would rather be an extremely complicated case in two dimensions, somewhat resembling a plate with many holes in it.

Professor Foster pointed out the extreme simplicity of the ideas employed to obtain the results which had been given. The subject has frequently been treated by mathematicians, but too often without regard to the physical point of view.

Dr. Guthrie then communicated a fourth paper, on salt solutions and attached water. It consists mainly of an account of an examination of the behaviour of a salt solution when cooled below the freezing point of water. Having shown in previous commnications that every salt solution, when of a certain strength, solidifies as a whole at a certain temperature as a cryohydrate, the present research was directed to the determination of the temperature at which (1) ice separates from solutions of strengths weaker than the cryohydrate, and (2) the anhydrous salt or some hydrate richer than the cryohydrate separates from solutions stronger than the cryohydrate. About twenty typical salts have been examined in this manner, and curves were exhibited in which the abscissæ represent strengths, and the ordinates solidification-temperatures. All the curves have a similar character, and exhibit a point of contrary flexure between the origin representing pure water at 0° C, and the cryohydrate. Between the cryohydrate and the 0° C degree of saturation, they are nearly straight lines, and are continuous with the curves of solubility above 0° C. The joint effect of two salts in depressing the temperature of ice formation was also examined. From previous experiments the general law that the temperature of a freezing mixture is identical with that of the solidification of the cryohydrate of the corresponding salt, appeared not to be the case with iodide of sodium. It now appears that this salt offers no exception to the general law, and that what was previously mistaken for the cryohydrate is really a sub-cryohydrate solidifying at a higher temperature. Certain remarkable cases of super-saturation were discussed, which show that a solution may be super-saturated in a three-fold manner; (1) with regard to ice, (2) with regard to a salt, and (3) with regard to the cryohydrate of the salt. The parallelism between a boiling saturated salt solution and a glaciating one was pointed out.

Professor Foster explained that when we have discontinuity in a curve we always must be dealing with two separate phenomena. He mentioned also that the portion outside the part of the curve between zero and the cryohydrate must be taken as representing super-saturation of ice, and that outside the upward curve from this point refers to super-saturation of salt.

At the meeting on April 8th, Mr. W. Spottiswoode, Vice-President, in the chair,

The following gentleman was elected a member of the Society:—Mr. H. M. Klaassen.

Prof. Foster exhibited and described an instrument for illustrating the law of refraction. It is founded on the well-known method of determining the direction of the ray after refraction by means of two circles described from the point of incidence as centre, the ratio of whose radii is the index of refraction. If the incident ray be projected to meet the inner circle and through the point of intersection a vertical line be drawn, the line drawn from the point of incidence to the point, where this meets the outer circle, is the direction after refraction. This principle is applied in making a self-adjusting apparatus as follows:—A rod, representing the incident ray, is pivoted at the point of incidence, and projects to a point about 4 inches beyond. To this extremity is attached a vertical rod, which slides through a nut in another rod also pivoted at the point of incidence. The lower extremity of the vertical rod is attached to a link, so fixed as to constrain it to remain vertical. By this means the two rods always represent respectively the incident and refracted rays. The index of refraction can be varied by altering the position of the nut, through which the vertical rod passes, on the rod to which it is attached.

Prof. Foster then exhibited a simple arrangement for showing the interference of waves. It consists of two glass plates placed one in front of the other, on each of which is drawn the ordinary sine wave. They are supported in a frame, and behind them is a paper screen bearing lines to indicate the points of maximum and minimum displacement. The plates can be made to slide in opposite directions, and all the phenomena of wave motion generally and the state of the air in open and closed tubes can be shown.

Lastly, he exhibited a method which has been suggested by Professor Kundt, for showing in a simple manner that the air in an organ pipe is in a contant state of alternate condensation and rarefaction. At the upper end of a closed pipe are placed two valves opening inwards and outwards respectively, and the chambers behind these are connected by indiarubber tubes with small water gauges, which, for the sake of exhibition, were projected on the screen. The gauges were to the eye

permanently set, showing at the same time condensation and rarefaction, an appearance which was of course due to the rapidity of change. It was shown that heats cause the air to approximate to its normal density.

Professor Guthrie exhibited and described an arrangement which he thought might be useful for determining the rate at which machinery is revolving. The instrument is analogous to one which he devised some years ago for rendering a galvanic current constant. The chamber of a manometer is connected with a small force pump, which makes one complete stroke for every revolution of the engine. A capillary glass tube affords a means of escape for the air introduced by the pump into the manometer. If now the pump be worked uniformly, that is the engine rotates uniformly, the pressure in the manometer will shortly attain a position of equilibrium, so that the mercury will remain stationary. But if the velocity of the engine increase, the mercury will immediately ascend, and so indicate this increase of speed. The main objection to the instrument, as exhibited, was the oscillation of the mercury, but this might be avoided in several ways, which were pointed out.

Mr. Coffin referred to some works in America, where he had seen a similar principle applied. The engine was connected with an air chamber, to which was applied a Bourdon's gauge, the indications of which gave an approximate measure of the revolutions of the engine.

Professor Unwin thought there would be some difficulty in keeping the capillary orifice perfect for any length of time. He referred to a proposal made by Professor Thomson in about 1852 to use a centrifugal pump for a similar purpose.

THE INSTITUTION OF CIVIL ENGINEERS.

At the eighteenth ordinary meeting of the session, held on Tuesday evening, the 28th of March, Mr. Geo. Rob. Stephenson, President, in the chair, the first paper read was on "Sewage Interception Systems, or Dry-Sewage Processes," by Mr. Gilbert R. Redgrave, Assoc. Inst. C.E.

VICTORIA INSTITUTE.

The Victoria (Philosophical) Institute held its usual fortnightly meeting at 10, Adelphi-terrace, on Monday, April 3rd, when Mr. Howard, F.R.S., read a Paper on the "History of Egypt in connection with the Bible."

At the meeting held on Monday evening, April 10th, a paper "On the Place of Science in Education," by Prof. H. Alleyne Nicholson, was read. The author reviewed generally the place which science ought to occupy in a rational scheme of education. The claims of science as an educational agent were considered as regards its disciplinary value, its utility, and its capacity of ministering to a higher culture. The relations between science on the one hand and religion and philosophy on the other hand, were also discussed at some length, and it was pointed out that science would not occupy its true position in education till it was admitted to have a secondary interest in causes and ends, in addition to its primary concern with phenomena. The author concluded by urging the importance in the investigation of truths, of whatever order, of maintaining an affirmative rather than a negative mood of mind, the true function of science being constructive rather than destructive. A discussion ensued.

Telegraph Companies.

DIRECT UNITED STATES CABLE.

The following official announcement respecting the interruption of the "Direct Cable" appeared in the *Daily News* of March 28:—

Sir,—I beg to inform you that the temporary interruption of this company's short cable, between Nova Scotia and New Hampshire, does not in any way affect the due transmission of messages between England and the United States and Canada, which are now sent from Torbay, Nova Scotia, by the company's alternative route via the lines of the Dominion of Canada and Western Union Telegraph Companies.—I am, Sir, your obedient servant, Charles S. Clarke, Secretary, Palmerston-buildings, Old Broad-street, March 27.

ANGLO-AMERICAN TELEGRAPH COMPANY (LIMITED).

The directors of the Anglo-American Telegraph Company (Limited) announce that they have resolved, after reserving £25,000 for the renewal fund, to declare an interim dividend for the quarter ending 31st March, 1876, of 1¼ per cent. on the Consolidated Stock, and of 2½ per cent. on the Preferred Stock, both free of income-tax, payable on the 1st May. £66,000, including £32,000 spare cable, has been carried forward to next quarter's account. The books of the company will be closed from the 7th to the 10th April, both inclusive.—*Daily News*, April 1.

WEST INDIA AND PANAMA TELEGRAPH COMPANY (LIMITED).

The traffic receipts of the West India and Panama Telegraph Company (Limited) amounted in January to £3,782, against £2,838 in the corresponding period of 1875.

EASTERN EXTENSION, AUSTRALASIA AND CHINA TELEGRAPH COMPANY.

The fifth ordinary general meeting was held on April 5th, at the Cannon Street Hotel; Mr. John Pender in the chair.

The Chairman said the total earnings for the half-year ending the 31st of December, 1875, were £109,366, and in the corresponding half of last year £110,759, thus showing a decrease of £1,393; the working expenses had been £41,515, and in the corresponding half of last year £31,934, showing an increase of £9,581. The current half-year included £13,209 for repairs to cables, and £5,305 for interest upon new debentures—total, £18,514; whereas for the corresponding half-year of 1874

the repairs amounted to £7,908, but excluding those extraordinary charges, there was a saving of about £1,000. The net revenue for the half-year was £67,851, and in the corresponding period of 1874 £78,825, showing a decrease of £10,974, caused by the breakage of the cables in November and December. An interim dividend of 1¼ per cent. had been distributed, and another of a similar amount would be payable on the 13th inst.; these would absorb £49,936, leaving the sum of £40,268 to be carried to reserve for part payment of duplicate cable to Rangoon. The old debenture debt was reduced by £1,500 during the current half-year, and since the 1st of January had been entirely liquidated. The cost of repairs had been £13,209, and in the corresponding period of 1874 £7,908, or an increase of £5,301, which was caused by the breakage of the Madras-Penang cable, which necessitated the expenditure of about fourteen miles of cable, and it was the cost of this cable which made up the general expenses. The debentures issued up to date were £270,700. This issue had been entirely confined to shareholders, and applications would be received from shareholders for a month, after which time the public would have the option of taking them. The amount of debentures unissued, to complete £300,000 for New Zealand contract, was £29,300; the further issue required, if the Rangoon cable was laid, was £20,000; the total unissued out of the authorised issue of £320,000 was £49,300. The New Zealand cable, 1,370 miles in length, had been successfully laid, and its electrical condition was in accordance with the contract, and had been approved by the company's engineers. The steamer *Edinburgh* had been taken over as the company's repairing vessel, and paid for, and the amount of the contract had been reduced by £10,000 in consequence of this company having shared in the risk of laying the cable. The word-rate was working satisfactorily. An interruption occurred in the Madras-Penang cable on the 13th of November last, and it was restored on the 24th of December. The great delay in making this repair was owing to the ship having an accident to her screw. In conclusion, the chairman moved the adoption of the report and accounts, and the declaration of the dividend recommended therein.

Mr. W. M'Arthur, M.P., seconded the resolution, which was put and carried after a short discussion.

The retiring directors, Baron Emile d'Erlanger and Mr. C. W. Earle, were re-elected; and Mr. John Ball and Mr. Henry Dewer were reappointed auditors.—*Railway News.*

CUBA SUBMARINE TELEGRAPH COMPANY (LIMITED.)

The number of messages passing over the lines of the Cuba Submarine Telegraph Company (Limited) during the month of March was 3,203, estimated to produce £3,000, against 2,688 messages, producing £2,786, in the corresponding month of last year. The traffic receipts for the months of December and January, which were estimated at £2,500 each, realised respectively £2,498 and £2,410.

GREAT NORTHERN TELEGRAPH COMPANY.

The traffic receipts of the Great Northern Telegraph Company for the month of March amounted to 371,467f., against 309,352f. for last year; and the total traffic receipts from 1st January to 31st March were 949,604f., against 828,354f. last year.

DIRECT SPANISH TELEGRAPH COMPANY.

The traffic receipts on the Direct Spanish lines, during March, amounted to £816 6s. 2d., against £1,475 3s. in the corresponding period of last year.

THE BRAZILIAN SUBMARINE TELEGRAPH COMPANY.

The ordinary general meeting of the shareholders was held on April 7th at the Cannon-street Hotel, under the presidency of Sir James Anderson.

The Secretary, Mr. Richard Collett, read the notice convening the meeting, and the report was taken as read.

The Chairman said that the report was a very short one, and, in fact, they began to learn that the less that was said in reports the better. The first matter was the slight diminution in the traffic. There was a diminution of some £6,000 revenue, but this was entirely owing to the fact that it had been such a bad half-year for commerce in that part of the world. The expenses had increased £800, which was principally due to two items—one was the expense consequent on attending the St. Petersburg Conference, and the other was the loss on the sale of the wooden huts at St. Vincent. The next point to which he would draw their attention was the effect of the word-tariff. (Hear, hear.) The balance-sheet did not show any effect of this, as they had simply one half-year compared with another under the old system. However, they had three months of the word tariff, and he was happy to say that it showed a manifest improvement. The number of messages had increased, and they would thus see the illustration of a common law in telegraphy: the greater the facilities, the greater the increase. This, while increasing the number of messages, had diminished the number of words. The average number of words when he began to have any association with telegraphy was 35 per message; the average now was about 19. The merchants had very properly learned to condense their language, and so arrange their words in code language, as to express many words in one. He had always been an advocate, more than most men, for never resisting this. The old plan was to charge one and a half times for all such messages, but some four years ago that was altered, and if people chose to say "Constantinople" or "London," it might mean what they like. He would no more go against the current of commerce, as a matter of policy, than he would try to run against the tide or current of a strong river. All sailors and engineers knew that they must humour the tides and currents, and they must do the same with commerce. The St. Petersburg Conference established that the length of a word should be ten letters, and that every group, whether two or four letters, should be called a word. They, therefore, had vir-

tually a letter-tariff, because they had the two units or groups, whether one, two, or three letters, and the extreme unit of ten. They were thus paid for the work done, and he looked forward to that as the basis below which they could never go, until some day some system of phonetic or shorthand telegraphy should be discovered; but they were nowhere near this at the present time. They were at the lowest basis to which they could descend, and he believed its utility had been proved by the fact that the merchants now sent three or four words to a distant part to ask a question, or to seek for an order, or to confirm something not quite clear in another telegram, whereas if they had had to pay for the whole twenty words, amounting to £10, £12, or £20, they would have hesitated. They had also the benefit of social telegrams, and thus they had arrived at a point beyond which the merchants could not beat them, and they now got the advantage of any outcome or growth which might arise from the facilities they gave. At the last meeting at which he had the honour to preside, there was a good deal said as to the directors. (Hear.) They were very hard upon the directors. (Hear, hear.) At that time they lost the services of two gentlemen who represented them, one in Brazil and the other in Lisbon. If they could have done without gentlemen of their standing or position, he believed they would have done so, but they found they could not. They had either to appoint directors or agents, and they could not afford to pay an agent an adequate salary to represent them, and no man going out in a merely official character, such as a clerk or a superintendent, could by any chance represent their wants at the Court and the Public Works Office. They had therefore appointed two gentlemen to fill the vacancies, and they were indebted to their colleagues, Messrs. Yule and Clerk, for securing the services of the two gentlemen. If the shareholders had any knowledge of the correspondence required, without which they could never keep their concession exclusive, as it now was, they would agree that they could not do without those directors. The cables were in good working order. There was still the small fault between Madeira and St. Vincent, but it had not altered. The cable was in good working order, and he had nothing gloomy to communicate.

A shareholder asked if the concession was a mere matter of caprice on the part of the Brazilian Government.

The Chairman, in reply, said that when they sought to make alterations from the original concession, as they did in adopting the word-system, they would never get permission unless the Brazilian Government thought proper. It required influence when changes were made; unless they were represented by men of influence it was difficult to effect those alterations. He then moved—"That the report and accounts of the directors now submitted be approved and adopted."

Mr. Matthew Hutton Chaytor seconded the resolution.

Mr. Wm. Abbott asked for some information as to the charge for the use of patents.

The Chairman explained that they could not work the cable at all without those patents. When the old Anglo-American cable was formed, the patentees demanded royalties, which, if they had obtained, would have given them £100,000 a year at the present time. Much negotiation went on, and much legal fighting, and it was agreed that they should receive something like £3,000 a year. The bargain then was that no company should use the patents at a cheaper rate. He had tried very hard to get them at a lower rate, but without success. In course of time one of the patents ran out, but they were clever enough to invent a much better one, so that they still "had" the company. All the electricians and schemers in the world had tried to beat these patents, but without success.

The resolution was then put to the meeting, when it was unanimously adopted.

A vote of thanks to the chairman and directors closed the proceedings.—*Financier.*

DIRECT UNITED STATES CABLE.

The ordinary meeting was held on Tuesday, March 28th, at the City Terminus Hotel; Mr. E. Harbord Lushington in the chair.

The Chairman, in moving the adoption of the report, said he proposed to enter into detail as to the past history, present position, and future prospects of the company. At the present time the shareholders were divided into two parties—viz., those who approved of the policy of the directors, and, on the ether hand, those who thought that their proceedings had been marked by incapacity and their expenditure by extravagance. The directors challenged the fullest inquiry into their policy, and were prepared to give every explanation which was required by the shareholders as to every item in the accounts. The company was established in 1873 with the view of affording an independent telegraphic communication to America. After considerable opposition, both at home and abroad, the laying of the cable was finally completed and opened for traffic in September, 1875. The directors had fulfilled their pledges. They had given the public 25 per cent. discount, and to the press the great advantage of 75 per cent. discount on all messages as compared with the rates of charges previously existing. From returns obtained from their traffic manager subsequent to the opening of the cable the directors had every reason to believe that the shareholders would obtain a handsome dividend upon their investments. The shareholders were aware of the numerous breakages which had occurred to the cable. Three breakages occurred in quick succession, and, as they were all aware, the cable was now again broken within twelve or eighteen miles of the American coast, but he was glad to say that, owing to the facilities afforded by their land line, they were enabled to transmit all messages without interruption. Referring to the efforts which had been made by outsiders for the purpose of bringing about an amalgamation with the Anglo-American Company, the deputy-chairman of that company was reported to have stated that it would be "midsummer madness" on the part of the Anglo-American to make any proposition to this company for the purchase of its cable to America. Now, he (the speaker) was not acquainted with that precise form of madness, but he really did think that it would be a much more serious form of madness for their company to go cap in hand to the Anglo-American, and ask them to buy the

cable for whatever they might please to give. This company was established as an independent company, and, under its articles of association, was precluded from amalgamating with any existing transatlantic company. The directors sincerely sympathised with the discontented shareholders on the depreciation of their property. They knew how painful it was to see their property fade away day by day, but they had no sympathy with the allies whom they had brought there to them. It was, however, well to see who those gentlemen were. The first of the gentlemen was Mr. Maynard; and who was Mr. Maynard? Had he borne with them the heat and burden of the day? Nothing of the sort. He became a shareholder about a month ago by the transfer of 10 shares into his favour, so that he had not even a voice in the proceedings of the day. It did not take long to discover the reasons why Maynard had become a shareholder. The fact was he had taken his shares to work the destruction of the company, whereas the directors held their shares to secure its prosperity. Returning to the question of breakages, he wished to explain why it was they had not a vessel on the spot to execute repairs. They were, of course, aware that the cable would be subject to accident, but to guard against it as much as possible, they went to the expense of making a cable stronger and heavier than usual, and took every precaution to guard against injury to it while it was being laid out of the track of the fishing boats. They had, therefore, good grounds to expect they would escape accident, and it was for that reason they had not had a repairing ship on the station. When the first breakage took place, not having a vessel to send out, they naturally looked to the contractors for help, and those gentlemen gave them the finest telegraph ship afloat to go to Newfoundland and pick up the cable. When the second breakage took place they had to take the same course, and so with the third, and when the breakage which took place the other day, and which was about 12 miles distant from the American coast, the cable was so thick that it could bear a strain of 14 tons. As regards this last accident, they had received information that Mr. Weaver, the manager of the Anglo-American Company, knew of the last breakage in this company's cable twenty-four hours before the fact came to the knowledge of this Board. It was stated that Mr. Weaver received a telegram from a captain of a vessel, whose anchor was foul of the cable, asking Mr. Weaver, in reply, what he would give in consideration of the anchor being slipped. To that Mr. Weaver replied, "Not a sixpence," and twenty-four hours afterwards this company got intelligence of the cable being broken. (Hear, hear). The directors had taken every possible precaution, by laying the cable outside the line of anchorage of fishing vessels, to avoid any breakage owing to the dragging of anchors; and it would have been impossible to have employed a smaller vessel than the *Faraday* to execute repairs during the late winter, as an ordinary repairing ship would have been no use whatever for the work required to be done. In fact, this company had been the first to demonstrate the possibility of picking up and repairing a cable from a great depth in the Atlantic during the winter season. Before the succession of breakages which had so unfortunately happened the receipts of the company had amounted to between £500 and £600 per day. He was sorry to say they did not amount to that sum now; but, nevertheless, public confidence in the company was again reviving, and the receipts were beginning to show a steady increase. The present rate of receipts, if it continued, would give a gross annual revenue of £120,000, making the gross receipts nearly 10 per cent. on the capital of the company. The directors would not at present put before the shareholders a proposition for doubling the deep sea cable, but it would be a desirable thing to accomplish whenever circumstances should warrant it. The board had issued £100,000 of debentures, which they had power to do under the articles of association. They had no other means of paying for the repairs of the cable, and if they could succeed in raising that amount of money they would then have the whole of their revenue free from any extraneous charge, and should they be so fortunate as to maintain and carry on the present rate of receipts during the current year, they would be enabled on the next occasion to pay a dividend to the shareholders.

Lord Bury seconded the motion, and disclaimed any intention on the part of the Chairman to impute unfair conduct to Mr. Weaver. All that the Chairman meant to remark was that Mr. Weaver knew of the breakage, and failed to inform this company of the fact.

Mr. Jackson complimented Messrs. Siemens on the energy and ability with which they had effected the repairs of the cable. As a holder of Anglo-American and other cable stocks, he thanked that firm for having enormously increased the value of cable property by demonstrating the possibility of repairing Atlantic cables in winter. The 1865 cable of the Anglo-American, which represented something like £700,000, had remained at the bottom of the sea, unused and useless, for three or four years. Referring to Mr. Maynard's circular, he questioned whether the present was the time to offer the property for sale. Referring to the expenses, he apprehended that the £68,000 expended last year did not constitute the normal working expenses of the company. He was connected with a French company, which carried on a similar business at a cost of £35,000 per annum, although in that case the cable was 1,000 miles shorter. There could be no doubt that £68,000 was too high an expenditure for one cable. The speaker expressed his opinion that this company might be made to pay 4½ per cent. with good management, and concluded by asking whether the directors were prepared to take up their full ratio of debentures.

The Chairman answered in the affirmative.

Mr. Jackson expressed satisfaction at the answer, and proceeded to urge that the board should be strengthened by the appointment of a practical engineer of experience to fill one of the two vacancies.

Mr. Maynard denied that he had any intention to injure the property; on the contrary, he was in favour of a Conservative policy, and was anxious to make the best of what they had got. He represented 13,000 shares, and it would be no small matter to throw them away. So far from being antogonistic, he was prepared to co-operate with the directors, and see whether or not, by union and strength, the company might not be extricated

from its present unfortunate position. As he wished for several particulars which did not appear in the somewhat bald report, perhaps the best course would be to adjourn the meeting until they could be obtained.

The Chairman could not consent to an adjournment. The office of the company was open to Mr. Maynard in common with other shareholders, and if he wanted information he could have obtained it very easily before that evening.

Mr. Maynard hoped the chairman would furnish the information, as he had refused to adjourn the meeting. With regard to the prospects of the company he was glad to say his calculations tallied with those of the chairman. Referring to the accounts, he found under the head of repairs a sum of £44,000 on account of the first two breakages. Of that sum £30,000 was for the first breakage, but it was not stated how much beyond the £10,000 would be required to cover the expense of repairing the second breakage. Again, with regard to the allowance of £15,000 by the contractors, would the chairman state why that abatement was made? He was further anxious to know whether the contractors received for the cable any sum beyond the contract price. He found that the cost of repairing the cable was five times greater than that of the Anglo-American. In his opinion the more economical plan would have been to have provided a repairing ship at the outset, instead of employing the *Faraday*. There was an item £6,817 for other creditors. Did that include any loans?

Lord Bury.—No; it is mainly due to the Post-office.

Mr. Maynard asked how much of the £100,000 debentures had been subscribed.

Lord Bury said they had not yet been received.

Mr. Maynard proceeded to show that allowing the revenue to continue at £120,000 per annum, by good management a dividend of 5 per cent. could be secured to the shareholders. He asked whether the directors were prepared to fill up the two new vacancies on the board from among the shareholders. He also alluded to the fact that Dr. Siemens, one of the directors, was also a member of the firm by whom the contracts had been undertaken, and concluded by moving as an amendment that the report and accounts be received but not adopted.

The Chairman said he was advised that the amendment could not be legally put.

Mr. Weatherby was afraid the directors considered more how they could play into the hands of a certain gentleman than how they could protect the interests of the shareholders. He complained that when they entered into the contract they had not made it a condition of payment to the contractor that the cable should be in perfect working order for thirty consecutive days. It was true they had secured the thirty days, but they had omitted the word "consecutive," and thus, when the cable broke, they had to go to the cost of repairing it—a cost which ought in fairness to have been borne by the contractors. Independently of that, looking at the large profits those gentlemen had made out of the company, they ought, he thought, to have come forward and taken that responsibility upon themselves. He denied that any one asked the board to go cap in hand to the Anglo-American Company, but he had to complain that when those who desired to get a good price for their property sent a circular among the shareholders pointing out the advantages of such an arrangement, the directors sent out a counter-circular throwing cold water upon and calling on them to reject it without discussion.

Mr. Tweed expressed his surprise that when the value of their property was depreciated to the extent of 60 per cent. the directors should take advantage of a technical objection to get rid of a motion which they did not like, and when he heard it objected to Mr. Maynard that he was the holder of only ten shares, he could only say that he regretted that the gentlemen who had the conduct of their property had not a more substantial stake in it than a mere qualification. He thought that when they started upon a competitive race with the Anglo-American Company they should, instead of quietly folding their hands as if they had nothing else to do, have procured a ship of their own to execute their repairs. He thought it highly objectionable that one of the contractors should be a director of the company, as it destroyed all confidence.

Mr. Guisden thought the submarine companies generally were maintained more in the interests of the contractors than of the shareholders.

Mr. Stewart strongly condemned the negligence of the directors in not having from the first provided a repairing ship.

After a few words from Mr. Labouchere,

Lord Bury defended the course taken by the directors in employing the *Faraday* to make repairs in preference to fitting out a repairing ship of their own. He thought, however, that the time had now arrived for making such an investment, and in this opinion he was supported by his colleagues on the board. Proceeding to give the information asked for by Mr. Maynard, the noble lord said the contract price for the cable was £1,240,000, and the abatement of £15,000 had been made by the contractors in consequence of the first breakage occuring so soon after the opening of the cable. It was true that the cost of repairing the breakage had fallen upon the company, in consequence of the omission of the word "consecutive" in the contract, but the directors were advised that the cable having been worked "thirty days," although not thirty consecutive days, the company was bound to bear the cost. He deprecated the attempts of outsiders to depreciate the value of the property by forcing on an amalgamation, and said as he had given £20 for each share he held in the company, he intended to hold on until he could sell at that price, if not with an increase. As to the cost at which the repairs were effected, the first contract was £30,000 for the first month's use of the vessel, equipped in every respect, and £5,000 per week after the expiration of the month. ("Oh!") A similar contract was entered into for the second, and for the third breakage the amount was reduced to £20,000.

Mr. Vears warned the meeting against Mr. Maynard, who had been connected with another company in which Baron Grant figured. ("Oh.") If a child were taken from its own mother and handed over to a gipsy there would be just as much kindness shown as in handing over this company to the tender mercies of Mr. Maynard.

Mr. Maynard defended his conduct in reference to the company alluded to, the Imperial Land

Company of Marseilles, and, while regretting that Mr. Vears had had the misfortune to be connected with that company, denied that there had been anything improper in his conduct as liquidator.

Dr. Siemens denied that he had used his position as director of the company to further the interests of his firm. On the contrary, it had made him determined that the cable should be the best that could be produced.

The amendment was then withdrawn, and the original resolution was carried unanimously.

Mr. Sawyer was re-elected an auditor of the company, and the proceedings then terminated.—*Railway News.*

Review.

Railway Appliances—A Description of Details of Railway Construction, &c. By JOHN WOLFE BARRY, Member of the Inst. of Civil Engineers.

THIS is another of those useful text books of science issued by Messrs. Longmans and Co., London. Some fifty odd pages are devoted to electrical appliances. Distant signals afford the author his first opportunity of dealing with this branch of the subject. Admitting that "the alteration in the "length of the repeating wire from temperature or "other causes is an objection to the mechanical "repeater, and constant attention to the condition "of the wire is required;" it is satisfactory to learn "this objection does not attach to the electrical "repeater," which is correctly described. With the light repeater, an instrument employed to tell the signalman whether the light in the lamp which forms his night signal is burning or not, he is not so correct. The temperature of the lamp *does not* maintain the contact of the two wires forming the electric circuit between the line wire and the earth. When the lamp goes out and the temperature falls, contact is *made*, not broken. The result is, however, the same as that given by Mr. Barry, viz., a bell is then rung, and the signal "light out" exhibited in the signal, box. Before leaving the subject of distant signals we must express a hope that ere long "electric repeaters" will be recognized as a part and portion of every signal which may, under any circumstances, whether fog, rain, or snow, independent of structural impediments, be hid from the view of the signalman. Recent events have so thoroughly shown the necessity of this that their general application can only be a question of time. If it is necessary to employ signals for the regulation of railway traffic, it is certainly necessary to know they act as they are intended to act. Railway signals, in common with all other mechanical appliances, are far from infallible; at the same time, they are the key of the section, and without their due action all the cost which railway companies incur for interlocking frames and block signals is simply thrown away.

In the chapter devoted to the block system, the "train staff" and "train staff and ticket" systems are ably dealt with, and few acquainted with railway working will be found to disagree with the verdict arrived at, that the safety of the latter is not so great as that afforded by the former. There is, no doubt, "greater opportunity for laxity in carrying out the regulations on which it depends." At best, it can only be, as Mr. Barry pronounces it, "a near approach to safety," for it affords no protection against *following* trains.

The "time" system, under which trains are kept apart at certain points only, by a certain interval of time, is very properly condemned, as affording, "even when it is perfectly carried out, no real security against collisions." The application of the "block system" is very clearly explained, and its gradual introduction and expansion, from its adoption on the Eastern Counties (now the Great Eastern) line, in 1844, traced. Much credit is justly accorded to Mr. C. V. Walker, and the officials on the South Eastern Railway, as being the first to thoroughly appreciate the merits of the block system. That the bell system introduced by Mr. Walker worked well, and that great praise is due to him and those under him for the admirable manner in which it was carried out, and which, no doubt, did much towards the further development of the block system of this day, none will dispute; but that *visible* electric signals "are not a necessity, even to a complicated system of traffic," is an opinion we cannot endorse. That a large traffic has been, or is being, worked without such aid, without mishap, speaks in the highest terms for those by whom it is so worked; but it would be, in our opinion, unsound reasoning to say, because such is the case in one instance, or in a dozen instances, that it proves visible signals are unnecessary. Visible signals cannot fail to be a great help to every signalman, and a further check against error. Not only should there be a visible signal to govern the road, but this signal should again be repeated back to the man who manipulates it, so that he may know it has acted properly.

(To be Continued.)

COMMUNICATIONS WITH LIGHT VESSELS.—The opening of communication between light vessels and the shore by means of carrier pigeons is in contemplation. Several gentlemen connected with the Trinity-house visited Harwich yesterday for the purpose of ascertaining what arrangements could be made in the event of the project being adopted. The birds could travel to and from that town and the Kentish Knock and sunk lightships, and would, it is thought, prove of great service in cases of emergency in conveying information relative to shipwrecks occurring within the district to which they would belong.—*Daily News*, March 15.

Correspondence.

E. PAGE.—The book "On Electric Railway Signalling" by W. H. Preece, we have ascertained, is out of print.—ED.

To Correspondents.

*** Duly authenticated contributions, theoretical and practical, on every subject identified with the interests to which "THE TELEGRAPHIC JOURNAL" is the organ, will always command attention. Anonymous correspondence will be wholly disregarded. Literary communications and books for review should be addressed to the EDITOR; business communications to the PUBLISHERS, 10, Paternoster Row, E.C.